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FAMILY LYCEUM.

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From the Journal of Education.

THE ECONOMY OF LITERARY AND RELIGIOUS INSTITUTIONS.

No principle in political economy is better established than that a liberal support of religious and literary institutions, is favorable to the pecuniary as well as moral prosperity of a people. This is apparent, in all ages of the world, in every country, and in all states of society; from the lowest class of Russians or Irish, to the most enlightened and refined circles in Europe or America. But we need not go so far to establish this important principle, in a system of means to produce the greatest amount of human happiness. It is evident at the present time, and in New England, it will recur to the recollection of the most careless traveller who has been in the different sections of our country, that the general prosperity in towns, villages, and counties, is nearly in proportion to the schools and religious institutions.

When the citizens of a town believe that they are *unable* to support clergymen and schoolmasters, they are always too poor, also, to repair roads, enclose their farms with fences, to repair the dilapidated buildings of their fathers, or even to replace the broken glass of a window, otherwise than by old hats and garments. But where public worship and common schools are well supported, it is common to see marks of general prosperity and individual wealth. There, the public common will be neatly enclosed, and private possessions will indicate not only prosperity, but taste.

These representations are not pictures, but facts, and establish the principle conclusively, that it is ever, as a course of worldly policy and thrift, better to support the two kinds of institutions, than to neglect them. The complaint of parents, that they cannot afford their children a good education, is therefore unfounded, as it will cost much more to bring them up in ignorance; and, when parishoners, on the plea of poverty, dismiss a good clergyman, it will in the same way fall as heavily upon their purses as their morals.

On this subject experience is the safest guide. We exist in a state of being, and in a country, where the support of our physical natures does not take so much of our time, but that much is left to be devoted either to idleness or improvement. We are, moreover, not only active, but social, and of course are generally employed in connexion with others.

The question then arises, how shall this surplus time be used, and our social principles gratified? It is better to gratify them in a course that will advance the mind, the moral and intellectual principles, than in a manner that will deprave both. The former course is cheap, the latter only expensive.—The most useful branches of education are uniformly the most expensive; yet many parents feel it a hardship that they must pay three dollars a quarter for instruction in the elementary branches of a useful education, while they pay ten dollars for the same instruction in dancing, and make no complaint.

On this point we have some statistics of our own. We know a town, in size about the third rate in New England, where schoolmasters receive five dollars and a half a month, and the clergyman is dismissed because the people are too poor to support him. This generation of paupers, however, give an ample support to two dancing schools, each of which costs them, directly and incidentally, a thousand dollars. These thrifty people are of course too poor to paint their houses, or replace a glass broken in the windows, or a hinge on the doors; yet they have the ability to take several sleigh rides in a winter, at the expense of two dollars each, and to call three times a day at the tavern, at the expense of six cents a time. It may be said that this is but *one* town, and an extreme case; but perhaps the reader may know many such towns, though it is hoped that he lives in a better.

How many towns in New England pay, collectively, one thousand dollars to support a tavern that would not give fifty, to found a Lyceum. Yet, where would he get the most instruction and rational amusement? Young men will pay five dollars at an assembly—a sum that would, for a year, pay more than their proportion to an institution that would not only advance themselves in knowledge, but have an increasing bearing on the improvement of all the young in their community.

Has not the reader himself, honest man as he is, sometimes paid two dollars to ride on the sabbath, though he now feels too poor to give one to a Lyceum, for a course of intellectual pleasure and instruction.

This principle of ours is uniform and invariable. Economy never stands in the way of improvement, which is itself the best and most lasting thrift. There is no saving can be made in vice and ignorance. It will save money, and character, and crime, and punishment, and remorse, to advance the moral and intellectual culture of our nature. This is the way to make us, indeed, lords of the lower creation, rising in intellectual dominion and perfection towards the Being who ordained it. J.

COMMON THINGS.

METALS.

UPON what can we fix our eye, which does not contain a metal, or bear its mark?—Even the precious metals, how common! though perhaps not quite so abundant in the hands of every one, as he would like. Over how many thousand feet of the surface of common things is gold spread?

And scarcely a person is so poor, that he cannot find a silver fourpence; or, as the Philadelphian would say, a *phip*; or, as the Carolinian, a *thrip*; or, as the Mississippian, a *picheoun*.

The tin mines of Cornwall have made themselves known by their inexhaustible treasures, all over the world. And what is there that does not contain iron? The rocks are colored by it. Plants and animals contain it. It even constitutes a part of our blood, and of course circulates in all our veins.—What instrument or article is there in civilized society, which does not bear the mark of iron?

Besides gold, silver, tin, and iron, we have copper, lead, zinc, antimony, bizimuth, cobalt, platina, manganese, arsenic: all useful in the arts and comforts of civilization, and many other bodies which are called metals.

And what are metals? What distinguishes them from other bodies? One thing which distinguishes them from all other bodies, is their *weight*. The heaviest metal weighs 23 times as much as water; the lightest of the common metals weighs more than 6 times as much as water.

The metals also possess greater *strength* than any other substance; and iron is the strongest of the metals, and on that account is in common use where great strength is required.

The metals are *malleable*; they can be beaten into leaves. Gold which can be beaten into leaves 280 thousandth part of an inch in thickness, is most malleable; and silver, next. Copper, lead, tin, and iron, can also be beaten or rolled into leaves.

The metals are *ductile*; they can be drawn into wire. A single grain of gold has been drawn into a wire 500 feet long. Iron and silver are exceedingly ductile. Copper, lead, and zinc, can also be drawn into wire.

Metals are *fusible*; they can be melted by heat. Mercury is fusible at the common temperature, and at the coldest temperature of the atmosphere we experience in this country. Lead, gold, silver, and copper, are melted without difficulty, iron with some difficulty, and platina with much.

The metals are *soluble*; many of the acids will dissolve some of them, and all can be dissolved by some one or two acids mixed. When once dissolved, they can be changed into various forms, diffused through a great space, and spread over a great surface. A piece of copper, as large as a pin's head, dissolved in nitric, sulphuric or acetic acid, may be so minutely divided, as to be diffused through a gallon of water, and by the aid of a little ammonia, give it a most beautiful and delicate blue. One ounce of gold, dissolved in nitro muriatic acid with the aid of ether, can be made to gild the whole surface of a wire which would reach round the earth.

The metals are *oxidized*. Some of them combine with oxigen readily; it is even difficult to prevent this combination. Manganese is almost always found in the state of an oxid, and it is difficult to reduce it to a metalic state. Iron oxidizes in the common atmosphere, more rapidly if moistened with water, and still more so, if moistened with an acid. Lead and copper oxidize to a very slight extent in the atmosphere, and entirely by the aid of heat or some acid.

There is a beautiful *variety* in the properties, and consequently in the uses, of the metals. The properties of iron, for example, admirably fit it for edge tools, besides many other uses to which it is applied. It is hard, strong, elastic, capable of being welded and tempered, and of receiving the power of magnetism.

When the properties of this metal, which is perhaps the only one essential to the arts of civilization, are known, a full explanation is given of the endless and innumerable uses made of it.

The great malleability of gold, and its resisting oxigen under all ordinary circumstances, are two properties wisely and beautifully united in that precious metal, and in some measure make amends for the small quantities in which it is found upon the earth, compared with lead, copper, and some other metals.

Most of the metals possess some properties peculiar to themselves, which bring them into use in some of the civilized arts; and many of them are so important, as to render them deserving of becoming the subjects of separate articles in a 'Family Lyceum,' which desert will probably be awarded to them in future numbers.

THE ARTS.

From Lardner's Cyclopædia.

GLASS.

MANY circumstances contribute to render glass one of the most curious and interesting of manufactured substances.

Although perfectly transparent itself, not one of the materials of which it is made partakes of that quality. Exceedingly brittle while cold, it becomes, by the application of heat, so remarkably flexible and tenacious as to be convertible into every form that fancy may dictate or convenience suggest. Its great ductility is shown in a very striking manner by the slender filaments—small as the fibres of a spider's web—into which it is spun for ornamental purposes. Many hundred feet of these filaments may be drawn out from a heated mass in the space of one minute. Its pliancy and elasticity are proved by the facility with which, when in the state just mentioned, it may be bent and retained in various forms, and by the energy wherewith its original shape is resumed at the moment of release from its constrained position.

The impermeability of glass to water, even under a considerable degree of pressure, is well ascertained. A few years ago, the reverend Mr. Campbell, while on a voyage to South Africa, among other philosophical experiments wherewith he amused himself, caused two globular glass bottles hermetically sealed to be lowered by means of leaden weights to the depth of 1200 feet beneath the surface of the sea. These, through the united and continuous exertions of ten men during fifteen minutes, were again drawn up, and were found to be perfectly empty.

The continued exposure of glass to the greatest heat whereby it is melted, does not produce any sensible diminution in its weight and quantity, or any alteration of its properties. It is capable of receiving colors, and of retaining them in all their lustre for an indefinite period. The strongest acids—with one exception that will be noticed—have no effect upon it; a circumstance that renders glass additionally useful in assisting the researches of chemists. It is capable of receiving the most perfect polish, preserves all its beauty, and does not lose the smallest portion of its substance by the longest and most frequent use.

The admirable qualities and important uses of glass have been so happily pointed out by one of the most celebrated writers of the last century, that no apology will be needed for the insertion of the passage.

'Who, when he saw the first sand or ashes by a casual intenseness of heat melted into a metalline form, rugged with excrescenses, and clouded with impurities, would have imagined that in this shapeless lump lay concealed so many conveniences of life as would in time constitute a great part of the happiness of the world? Yet by some such fortuitous liquefaction was mankind taught to procure a body at once in a high degree solid and transparent, which might admit the light of the sun, and exclude the violence of the wind; which might extend the sight of the philosopher to new ranges of existence, and charm him at one time with the unbounded extent of the material creation, and at another with the endless subordination of animal life; and what is yet of more importance, might supply the decays of nature, and succor old age with subsidiary sight. Thus was the first artificer in glass employed, though without his own knowledge or expectation. He was facilitating and prolonging the enjoyment of light, enlarging the avenues of science, and conferring the highest and most lasting pleasures; he was enabling the student to contemplate nature, and the beauty to behold herself.'*

The utility of a substance which is daily and hourly rendered serviceable by all classes of persons in almost every human habitation cannot need to be exemplified. The aids which it offers to scientific researches are almost equally apparent. To notice the particular arrangements whereby the chemist, the naturalist, or the astronomer avails himself of some of the various properties of glass in pursuing his investigations, would lead to descriptions which, although interesting in a high degree, are foreign to the object of this treatise, wherein little more than incidental notices can be given, on points that have relation to improvements in the manufacture.

It may be useful, however, to notice here an error, not unfrequently made, from observing glass to be the only transparent material used in making spectacles, opera glasses, and other optical instruments.—Persons are induced, from this circumstance, to ascribe to the peculiar quality of glass the exclusive power of modifying the apparent magnitude, brightness, and distinctness, of objects seen through it. This, however, is not an exclusive property of glass, but belongs to every transparent substance having a density different from that of the air which surrounds the observer. It depends also, not alone on the inherent qualities and density of the transparent substance through which the objects are viewed, but also on the form of the surface which bound that substance, and on various other circumstances not necessary to be noticed more particularly here. The reader will, therefore, recollect, that the optical properties of glass are common to the diamond and other transparent solids, to all transparent liquids, and even to gases. Glass is commonly used on account of its cheapness and durability, and for other reasons of convenience.

It is impossible, however, wholly to dismiss this subject unaccompanied by expressions of admiration at the genius of those master spirits, who, by their discoveries and inventions, have rendered glass subservient to purposes that open and enlarge the field of human knowledge in some of those branches of natural philosophy which tend most to refine the nature and exalt the character of man.

Familiarized as we are to the use and appearance of glass, yet no person can ever become indifferent to its advantages, or insensible to its beauty. Neither can we feel astonishment at the admiration which induced the ancients, while the art of making it was little practised, and in those countries where it was not yet established, so greatly to covet the possession of glass vessels as to purchase them at prices which to us appear exorbitant. We are told that the emperor Nero gave for two cups with handles 6000 sestertia, a sum nearly equal to £50,000 of our money. These vessels were not of any extraordinary size, but were thus highly valued on account of their perfect transparence, and resemblance to crystal.

The name whereby this material is known to us is generally said to be derived from the Latin, and to have been suggested by its great similarity in appearance to ice *(glacies.)* It has been remarked, however, that the common Latin designation is *vitrum*; and as the Romans gave this name also to the plant which we call *woad*, and which our remote ancestors called *glastum*, it is imagined that glass obtained the same distinctive appellation, because of the bluish tint which it usually exhibited. There is as little probable foundation for one as for the other conjecture, nor is the question of much importance, since, whichever way it might be

* Rambler, No. IX.

determined, no light would be thereby thrown upon any point of interest concerning the origin of the manufacture, which, although involved in the most impenetrable mystery, is yet known to have existed long before its introduction among the Romans.

The passage in the book of Job (ch. xxxvii. v. 18.) wherein mention is supposed to be made of glass, has been adduced by Neri in proof of its remote origin. Unfortunately for the correctness of this opinion it has been found, that in many ancient versions, instead of the *glass* of the Vulgate and Septuagint, other substances which have diaphanous and shining properties are mentioned. In fact, the word in the original Hebrew has been frequently used, according to the fancy of translators, to signify different bodies possessing lustre and transparency.

The two problems of Aristotle—if, indeed, they were propounded by that philosopher—'Why do we see through glass?' and 'Why is it not malleable?' comprise, perhaps, the earliest written mention made of the substance. Theophrastus, whose writings are not half a century later than the time of Aristotle, mentions the use of sand from the river Belus in making glass; and from that date (300 years B. C.) a knowledge of the material was pretty generally diffused. If reliance is to be placed upon the statement, that the celebrated sphere of Archimedes was made of glass, the art must in his time (209 years B. C.) have arrived at a considerable degree of perfection.

Many authorities concur in assigning the merit of the invention to the Phœnicians; and the assertion of Pliny is often repeated, which attributes the discovery to accident. Some storm-driven mariners were boiling their food on the sands at the mouth of the river Belus—a small stream running from the foot of Mount Carmel in Galilee—where the herb kali was growing abundantly, and are said to have perceived that the sand, when incorporated with the ashes of this plant, melted and ran into a vitreous substance. It is certain that the sand about this spot was well adapted to the manufacture of glass, and probably the glass-houses of Tyre and Sidon were supplied thence with this material, which may have given rise to the tradition.

That the ancient Egyptians were well acquainted with the method of making glass cannot be doubted. The beads where with some mummies are adorned, although composed of earthenware, have an external covering of glaze, which is true glass covered with a metallic oxide; and recent searchers have discovered among the tombs at Thebes some pieces of glass of a blue color, similar in their composition to the glazing on the beads just mentioned.

The glass-houses of Alexandria were long famed for the skill and ingenuity displayed by their workmen. The Romans were, at one time, supplied with a great part of their glass ware from that city. A coarse and impure manufacture of drinking vessels had been prosecuted at Rome from the time of Nero; but the art could have made only a slow progress notwithstanding the encouragement offered by the high prices at which glass wares of foreign make were sold in the imperial city. The emperor Hadrian, while at Alexandria, received from a priest some glass cups of various colors, which had been used in the worship of the temple, and transmitted them to Rome as objects of great value and curiosity, with an injunction that they should be used on festivals and other great occasions.

Utensils of glass have been found among the ruins of Herculaneum, which city was destroyed in the reign of the emperor Titus, by the same eruption of Mount Vesuvius which cost the elder Pliny his life. It does not appear that glass was used for admitting light to dwellings in Herculaneum, the largest houses having windows made with a species of transparent talc.

In the British Museum are four large cinerary urns made of green glass, which have been pronounced by a very competent authority favorable specimens of the proficiency of the ancients in the art of glass-blowing. These are round vases of an elegant form, furnished with covers and two double handles. The formation of these handles is, it is said, 'such as must convince any person capable of appreciating the difficulties which even the modern glass-maker would have to surmount in their execution, that the ancients were well acquainted with certain branches of the manufacture.'

Several ancient authors *(Dion Cassius, Petronius Arbiter,* and *Isodorus)* relate, that in the reign of Tiberius, an architect, who had been banished from Rome on account of his great popularity, having, in his retirement, discovered the means of so far altering the nature of glass as to render it malleable, ventured to return to Rome, in the hope of securing both a remission of his sentence and a reward for his invention. This discovery not agreeing, however, with the supposed interests of the tyrant, who feared lest the value of gold might be lowered by its means, the architect was beheaded, and his secret died with him. This is, probably, only another version of the story related by Pliny, of the same important discovery having been made by an artist in Rome, when such of the populace as imagined that their interests would be injuriously affected thereby conspired together and destroyed his dwelling.

A similar discovery, attended by results as unsatisfactory, and which is said to have occurred in France in the more modern times of Louis XIII., is recorded by Blancourt. He says, that the inventor having presented a bust formed of malleable glass to the cardinal Richelieu, was rewarded for his ingenuity by perpetual imprisonment, lest the 'vested interests' of French glass manufacturers might be injured by the discovery.

Without venturing altogether to deny the truth of these stories, it would be hard to subject to the charge of presumption those persons who entertain doubts upon the matter. It does not, certainly, prove the incorrectness of the statements, that no subsequent examiner into the arcana of nature has been equally fortunate; and it is assuredly *possible* that some successful investigator may yet be the means of revealing that which has already been thus ascribed to more than one experimenter.

Improbable as the achievement of this would seem, it would be scarcely more extraordinary than the transformation of linen rags into sugar, or the conversion of sawdust into 'wholesome, palatable, and nutritious food.' The purposes both of use and of ornament to which glass would in such a case be applied are almost endless, and their importance can hardly be overrated; nor should we in these days have occasion to fear, lest the insensate obstructions of some modern Tiberius or Richelieu should step between the discoverer and the promulgation of his secret.

According to our present amount of knowledge, the chance of realizing such a discovery is, however, limited within the barest possibility. The quality of malleability is in direct contradiction to that of vitrification; the existence of the one state seems to be incompatible with that of the other. Some metallic substances when greatly urged by fire are made to approach towards the state of glass, and then lose their malleability; a fact which almost implies the impossibility of imparting the latter property to glass. Kunkel has indeed observed, that it is possible to produce a composition having an external glassy appearance, which should be pliant and capable of being wrought under the hammer; and Neumann tells us, that in the fusion of muriate of silver a ductile kind of glass is formed, which may be moulded or turned into different figures, and which may be pronounced in some measure malleable; facts to which Henckel has referred in order to account for the traditionary stories of the ancients.

GEOLOGY.

MICA.

BEFORE the manufactory of glass was discovered, houses, ships, and other buildings, were furnished with light, through the medium of several transparent substances taken from rocks. A great part of Russia is at this time furnished with glass for their houses, by a substance which, from its use, is called Muscovy glass. It is also called isinglass, and by mineralogists, *mica.*

This substance, though less abundant than quartz or felspar, the two substances already described, is one of the essential ingredients of the oldest rocks, particularly granite, gneiss, and mica slate.

In the oldest granite, the first solid substance formed from the original chaos, when it was said, 'Let dry land appear,' the plates of mica are larger than in any other rock, sometimes a foot or more in diameter. In the more recent and more common granite, though abundant and diffused through the whole mass, the plates are in small thin scales, not often as large as a fourpence. In gneiss the scales are still smaller, but more regular in their arrangement. In mica slate, the mica constitutes a large part of the rock, but is so minutely combined with quartz, the other ingredient, as, in most specimens, not to be distinguished or separated.

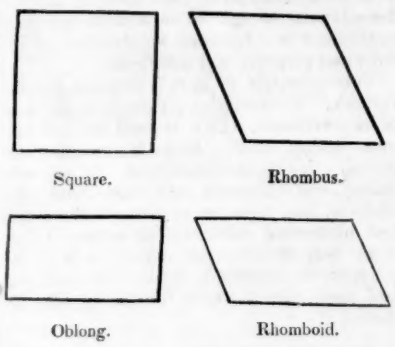
Though granite, gneiss, and mica slate, are the deposits of much the greatest part of mica, upon our globe, it is not confined to them, but is frequently found in sienite and sandstone, and sometimes in greenstone and porphyry. Beds of sand usually contain a large quantity of mica, and through some soils, especially silicious soils, it is more or less diffused.

The four earths mentioned in the first number of the Lyceum, enter into combination to form mica, and nearly in the following proportions: Silex, 50; Alumine, 35; Magnesia, 1,35; Lime, 1,33.

Besides these, potash, iron and manganese, enter into the composition of this simple mineral, which composes part of the oldest and most abundant rocks upon the earth.

GEOMETRY.

PARALLELOGRAMS.



IN the second number of the Lyceum, a few of the very numerous uses of parallel lines were mentioned. It will also be seen, by a diagram of squares connected with the subject in that number, that different pairs or sets of parallel lines are sometimes made to cross each other, and for very important purposes.

It will be seen, by a glance at the diagrams connected with this article, that four different shaped figures may be formed by two parallel lines crossing or meeting two other parallel lines. If each pair are equally distant, and cross each other at right angles, the figure formed by this meeting, will have all the sides and angles equal. If the two pairs cross or meet each other at right angles, but at unequal distances, they will form a figure with all the angles equal, and the opposite sides. If they are equally distant, but meet at oblique angles, the figure will have all the sides equal, but only the opposite angles. If their distances are unequal, and the angles oblique, the opposite sides and angles will be equal, but not all the sides, or all the angles.

The reader, by comparing the four cases here mentioned, with the diagrams, will be able to give the specific name of each of the four parallelograms, which are all the different kinds that can be formed by the crossing of any two pairs of parallel lines, in any position or relation in which they can be placed.

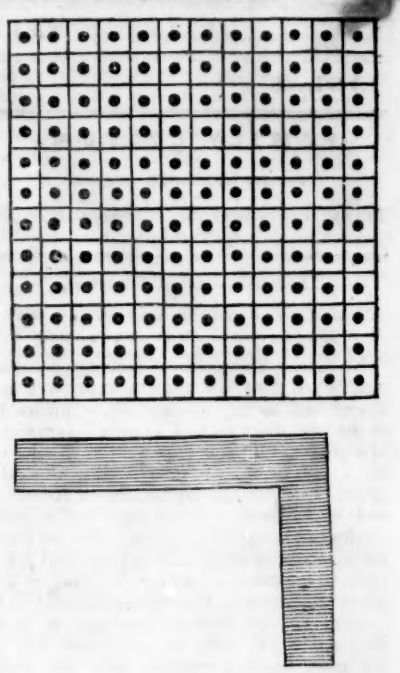
When it is ascertained, that there can be formed but four different kinds of parallelograms, and their properties, relations, and names, rendered familiar; it may be well for the reader to cast his eye around him, or for a parent to ask his child to do it, to ascertain whether the square, oblong, rhombus, or rhomboid, is most common. Any person, even a child of three years old, will be able to tell which of the four parallelograms are the table, door, each pannel of the door, the windows, each pane of glass, the sides of the room, the wall, the floor, each board in the floor, the carpet, the hearth, a book, each leaf of a book, the door steps, the flag stone, the sides of houses, yards, gardens, fields, gates, and fences, each board, stone or brick in a fence or wall, and thousands of other objects which will meet his eye, and which a student or an observer had better *discover for himself,* than to have them pointed out.

In our last number it was mentioned, that the triangle was more useful in the investigation of science, if not in prosecuting the arts, than any other figure; and next to triangles, parallelograms will probably be found to be more useful than any other figure. Indeed, the first thing the triangle does, in many cases at least, is to bring to its aid a parallelogram, every one of which can be divided into two equal triangles, by a line passing from one corner to the opposite, which line is called a diagonal.

In the figure of squares, or 144 parallelograms, represented under the head of apparatus, in this number, it will be seen, that multiplying two sides of any square into each other, will give the contents of that square. It may hereafter be shown, that by multiplying two adjacent sides of any parallelogram into each other, we shall find the contents. We hope also to be able to show, that by multiplying into each other the length, breadth, and thickness of any solid enclosed entirely by parallelograms, we shall find the contents of that solid.

APPARATUS.

ARITHMETICON.



THOSE who have examined the numeral frame, or Arithmometer, in the last number of the Lyceum, and become acquainted with its uses, will be prepared to appreciate the importance of the *Arithmeticon;* for, to some extent, they both have the same object, and are used by a similar process; though one is a frame, and the other a sheet. The Arithmeticon is nothing more nor less than a sheet or card with 144 squares, with a dot in the centre of each; with a brief explanation, principally by questions relating to the diagram, and its uses. The 144 dots are designed for counters, to aid the mind in combining and comparing numbers, by adding, subtracting, multiplying, dividing, &c.—By applying the square, or sector, represented above, any number, or any combination of numbers, can be cut off, and presented separately to the mind of a child.

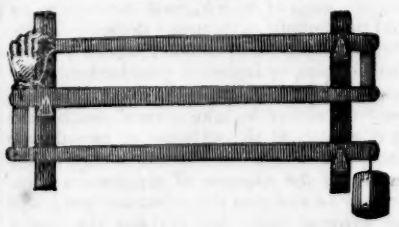
By placing the sector at the bottom and left hand side of the Arithmeticon, so as in the first instance to separate one dot from the rest, the impression of unity, or one, will be made upon the mind; if the sector then be carried one place farther to the right, unity repeated once, or the idea of two, will be impressed upon the mind. By continuing the process, three, four, five, &c. will make their appropriate impressions, each being clear and distinct, if the mind is not carried along so fast as to produce confusion, by several names without ideas.

When the child's mind has progressed as far as four, without confusion, it is prepared to see and to *know,* that two twos are four; and that half of four is two; and of course, to perform a process in multiplication and division. And if the child is not pushed beyond his strength, but permitted to 'grow with his growth and strengthen with his strength,' he will move on from step to step, almost entirely by the vigor of his own intellect, until he has a clear and rational view of all the combinations of numbers given in common tables, and satisfactory to the mind, because it is the fruit of its own labor, and because all the perceptions are clear, and each distinct from all the rest.

An Arithmeticon is prepared for schools, upon so large a scale as to be seen distinctly by fifty or a hundred pupils; another upon a small scale, is pasted upon a card, for the instruction and amusement of children by each other, or by their parents while at home.

By referring to the article on Geometry, it will be seen, that this sheet or card serves for various illustrations in mensuration, as well as for the combinations of numbers.

COMPOUND LEVER.



WE witnessed, not long since, a most powerful operation in a piece of machinery, in a manufactory. A bar of iron, 1-2 or 3-4 of an inch thick, was perforated into holes of nearly an inch diameter, apparently with as much ease, and with more despatch, than the tinner punches a sheet of tin.

Machinery is also prepared for raising stone, by which the strength of a boy twelve years old will raise ten tons. An instrument called the *jack*, so light that a man can carry it without inconvenience, is much in use in granite quarries, and admits of such an advantageous application of power, that one person can by it shift masses of rock from one position to another, of a greater weight, and with greater ease, than six persons could do with instruments commonly used for moving heavy bodies.

All these instruments referred to, are combinations of levers, acting upon each other. Few persons, and even mechanics who are in the constant use of machines composed principally of levers under one form or another, are aware of the immense increase of power gained by bringing one lever to act upon another, and still more by causing several levers to act upon each other.

The principle of compound levers, or a set of levers acting in succession upon each other, will be readily understood by examining the diagram above, which represents three levers connected. The power is supposed to be applied where the hand is placed, which is at the end of the long arm of the first lever, which is ten times as long as the short one, placing the hand ten times as far from the fulcrum, as is the connection with the second lever; consequently, one pound weight exerted upon the first lever, will move ten pounds. Each of these acting upon the long arm of the second lever, will move ten, and of course the whole will move a hundred. Each of these hundred acting upon the third lever, will move ten; of course the whole will move a thousand pounds; that is, one pound applied to a lever which is made to act upon another, and that upon the third, the two arms of each, in a decimal ratio, will move a thousand pounds.

But it must be understood, that the compound lever can be applied only where great power for short distances is required; for if one pound is so applied by the bar or any other instrument, as to move a thousand pounds, while those thousand pounds move one inch, the one pound must move a thousand inches.

The wheel and axle, which is nothing more than a modification of the lever, is frequently so compounded with that and other instruments, as to produce very powerful, important and curious operations. But these will be explained and illustrated by drawings in a future number.

From the Young Mechanic.

Boston Mechanics' Lyceum.

ORIGIN.

As this institution, owing to its somewhat peculiar character, is but partially known among the mechanics of our city, I have thought proper to prepare an account of its origin, and progress to the present time.

The first meeting in favor of forming a Mechanics' Lyceum in this city, was called February 5th, 1831. Mr. Timothy Claxton presided, and Mr. W. S. Baxter acted as Secretary. The evening was occupied by the discussion of the question, 'Has any class of the community stronger inducement or better opportunities for mental improvement than practical mechanics?' which was decided in the negative. The meeting adjourned to Feb. 12th, for the discussion of another question, and to take into further consideration the subject of forming a Lyceum.—At this meeting a proposition was made to form an association to be called the 'Union Lyceum,' and another to form one to be called the 'Mechanics' Lyceum,' both of which were referred to the next meeting, which was voted to be held Feb. 19th. The latter proposition prevailed at this meeting; and a committee was appointed to draft a Constitution, to be reported at an adjourned meeting, Feb. 25th. The Constitution reported by the committee at the meeting of this date, was adopted, with a few amendments. The following is a copy, with the exception of two or three amendments which have since been made, the only one of which of any importance, is the alteration of the annual assessment from $2 to $1.

CONSTITUTION.

Art. 1. The Society shall be known by the name of the Mechanics' Lyceum. Its object shall be, mutual improvement in useful knowledge.

Art. 2. Any person, having been proposed at a meeting of the Society, and elected by a vote of two thirds of the members present at a future meeting, by signing this constitution, and paying one dollar, shall be entitled to all the privileges of membership.

Art. 3. There shall be an annual assessment of one dollar on each member, payable on the first of September. No member will be allowed to attend the exercises of the Lyceum, until he has received his season Ticket; and any person neglecting to procure a ticket for one year, shall forfeit his membership.

Art. 4. The meetings of the Society shall be held once a week, for discussions, lectures, or such other exercises as may be thought best to accomplish the object of its members. The last meeting in each season shall be the annual meeting, when the committee shall make a report of the doings of the past year, after which a new committee shall be chosen.

Art. 5. The business of the Society shall be transacted by a committee of five; viz. a President, Secretary, Treasurer, and two Curators, who, together, shall constitute a Board, to take charge of the affairs of the Society, and to devise and recommend such measures, as in their judgment they shall deem expedient.

Art. 6. Each member shall have the privilege of introducing ladies to witness the exercises; who may hand in compositions on the subjects under consideration, or on such others as they may choose.

Art. 7. This constitution may be altered or amended by vote of two thirds present at any regular meeting, the same having been proposed in writing, at a previous meeting.

After the adoption of the Constitution, the following persons were elected officers for the first season:—Timothy Claxton, President; George W. Light, Secretary; James Cooper, Treasurer; William S. Damrell and Joseph Wightman, Curators.

FIRST TERM.

At the first regular meeting of the Lyceum, the following list of exercises was proposed and adopted:

March 5.—1. Matter and its properties. 2. Attraction. 3. Repulsion. 4. Motion from forces in the same direction. 5. Motion from forces acting in various directions. 6. Centre of gravity. 7. Essay addressed to Mechanics.

March 12.—*Question.*—'Which has been the greatest benefit to Mankind, the discovery of the Magnetic Needle, or the invention of the art of Printing?'

March 19.—1. Lever and Balance. 2. Wheel and Axle. 3. Pulley. 4. Inclined Plane. 5. Wedge. 6. Screw. 7. Essay, Rise and Progress of Mechanics' Institutions.

March 26.—*Qnestion.*—'Are Females endowed by nature with intellectual abilities equal to those of the other sex?'

April 2.—1. Air, Atmosphere. 2. Weight of the Atmosphere. 3. Pressure of the Atmosphere, Barometer. 4. Common Pump. 5. Elasticity of Air. 6. Fire Engine. 7. Essay, Economy of Fuel, and Construction of Chimneys.

April 9.—*Question.*—'Which is most conducive to happiness, Ignorance or Knowledge?'

April 16.—1. Water. Rivers. 2. Springs. 3. Pressure of water. 4. Water Wheels. 5. Water Pumps. 6. Water Syphon. 7. Essay on the Ocean.

April 23.—*Question.*—'Are the modern improvements in labor-saving machines, beneficial to the community?'

April 30.—1. Printing Press. 2. Screw Standing Press. 3. Hydrostatic Standing Press. 4. Steam Engine. 5. Steam Boat. 6. Steam Carriage. 7. Essay on the Mechanic Arts.

May 7.—*Question.*—'Are early marriages generally advisable?'

May 14.—1. Definitions of geometrical figures. 2. Definitions of geometrical solids. 3. Mensuration of right lined figures. 4. Mensuration of curved lined figures. 5. Mensuration of solids with plane faces. 6. Mensuration of solids with curved surfaces. 7. Essay, History of Geometry.

May 21.—*Question.*—'Which has the greatest influence in forming the character of the child, the father or mother?'

The subjects of the Lectures here enumerated, together with those of the Essays, were treated upon by the members of the Lyceum—seven of them taking parts on the evenings of the Lectures, and each one occupying about a quarter of an hour. Essays on the subjects for debate, were written by females introduced by members of the Lyceum, which gave an increased interest to the discussions, and exhibited a laudable talent for composition, which the females of our community, especially the wives and daughters of mechanics, are seldom acknowledged to possess.

At the last meeting of the season, May 5th, the same officers were chosen for the second term, except that Mr. William S. Baxter was elected a Curator in the place of Mr. William S. Damrell.

SECOND TERM.

At the first meeting, June 7th, the following subjects for Lectures were adopted:—Architecture; Political Economy; Botany; Geology; Natural History; Astronomy; Biography of Practical Men. The members were left to choose their own subjects for Essays. At the next meeting, Sept. 27th, it was voted that Declamation should be added to the regular exercises of the Lyceum, which was afterwards found to increase the interest of the society, as well as to elicit a species of talent, and effect an improvement which has been too long and too much neglected. It also had the tendency to increase the confidence of speakers in debate.

At the last meeting, the following persons were elected officers for the third term:—Timothy Claxton, President; Joseph Wightman, Secretary; Elisha Tower, Treasurer; William S. Baxter, and Dunbar B. Harris, Curators.

As to the success of the Lyceum, thus far, notwithstanding its number of members has been small, the improvement of those who have devoted their attention to it, has exceeded the anticipation of the projectors. They now feel confident, that the plan of having the exercises conducted by the members alone, is not only in accordance with the true Lyceum system, but far more productive of solid improvement, than the mere attendance upon popular lectures. In the one case, the members acquire a habit of doing their own studying and speaking, and consequently of calling into exercise the faculties of their own minds, and using the means for improving their own manner of delivery; while in the other, most of the hearers of popular lectures retain little of the instruction they receive, and are too apt to go away with the impression, that because the lecturer's duty is performed, their own task is as certainly completed. If the former obtain only a *smattering* knowledge of science—which we maintain is not the case—the latter do not acquire even *that*. It is not my design to derogate in the least from the real merits of the popular system of conducting Lyceums. While kept within its proper sphere, it may be of extensive benefit, but I do maintain, that popular lecturing ought not to be the *regular* exercise of any institution, the professed object of which is *mutual* improvement. I am aware of the difficulty of giving very great popularity to an Association which depends wholly upon its own resources for advancement in knowledge; but still I am of opinion, that the improvement of a Lyceum depends as much upon the faithful exercise of its own powers, as that of an individual does upon his own efforts.

Among the results of the institution, I may mention the existence of The Young Mechanic, a work devoted entirely to the interests of mechanics. The subject was first agitated by a number of the members, who afterwards executed all the necessary measures for its establishment.

George W. Light.

House of Reformation for Juvenile Offenders.

The recent return of the day assigned for the admission of visitors, afforded another opportunity to observe the grand moral revolution which is constantly going on in this institution and the methods and manner by means of which it is accomplished. The scene exhibited on these occasions and the emotions which it naturally excites, though familiar to some, are yet too interesting in themselves and attest too strongly the claims of the respected superintendent of the institution, to the grateful sympathy and esteem of the community, not to merit repeated recital.

When the visitors had seated themselves, Mr. Wells blew a small ivory whistle, and forth from the door of the adjoining apartment, issued a company of upwards of seventy lads, clad in a simple but uniform manner. They advanced with folded arms and in regular order, and forming in lines before their teacher, followed him in singing a beautiful and appropriate hymn.—They then answered various questions, relating to the elements of Arithmetic, Natural Philosophy, Botany and Chemistry. These studies, especially the three last, are only pursued at leisure intervals and by way of pastime.

The recitations were agreeably varied by occasional relaxation, the exhibition being intended to convey an idea of the discipline generally pursued. Many of the boys manifested considerable agility in their gymnastic exercises.

Questions relating to moral obligation, duty to God, benevolence, &c. were next proposed and answered in a manner plainly indicating that these subjects were *understood*, and not mere matters of memory.

Marching, in which the boys are very expert, was accompanied by singing, and these vocal lessons were all of such an excellent character and so melodiously chanted, as to convey the most beautiful and harmonious images and influences to every heart.

The evening prayer closed this exhibition, in which the responses of youthful devotion mingled with the supplications of mature piety.

There was that in the looks of the boys, in the whole appearance of the institution and especially in the deportment of the principal, which spoke of benevolence, mutual confidence and moral dignity. The idea of crime and wretchedness from which these youths were rescued, occured not to the spectator, except as contrasted with the present delightful spectacle. It presented itself only to awaken a throb of gratitude and call up bright visions of futurity, in which the 'jewels' of the faithful preceptor, shone in the crown of his heavenly reward.

Henricus.

Lectures on Education.

We are happy to learn, by the Connecticut papers, that Mr. Jewett has made arrangements for Lectures on Common Education, in some thirty or forty towns in that state. The peculiarly happy results which attended Mr. Jewett's lectures in New Hampshire, and the western part of this state, last season, must give great confidence to the friends of education in Connecticut, in the importance of his visit to them on so important an errand.

If we understand the character and object of Mr. Jewett's lectures, it is to present to the meetings he may attend, some of the modern and most important improvements in education, and to exhibit them by such explanations and illustrations, by the aid of apparatus, diagrams, &c. that any teacher or parent can adopt them for the benefit of their children and pupils.

We cannot believe that any parent, teacher, or other friend of education, who can avail themselves of Mr. Jewett's instructions, will fail of the opportunity of benefitting themselves, or of contributing something for what they receive and he renders.

School Statistics.

The National Education Society of England, which has been in operation twenty years, has established schools in 2,609 places! at which are taught 123,182 boys and 93,389 girls.

The British Foreign School Society have established Central Model Schools, at which have been taught 3,730 pupils, among whom were 20 Arab youths.

The Society for the Diffusion of Useful Knowledge, with Henry Brougham at its head, has done much for the instruction of the laboring classes.

In Scotland, a school is established and supported in every parish, by a law enacted in 1698. At that time, there were in Scotland from 50 to 75,000 common beggars; now, they are rare.

4,166 persons, of 7,394, committed for offences in France could neither read nor write.

Frederick the Great established Patern Schools, which all teachers were required to attend, and required every child in the kingdom to attend some school, whether its parents were able to pay or not.

There were in Prussia, in 1826, 20,887 Primary Schools, and 736 of a regular grade, taught by 22,262 masters, and 704 mistresses.

Circuit Schools.

A prominent object of the 'School Agent Society,' is to establish, and aid in conducting, Circuit Schools or Lyceums. The plan of these schools is, to have every town and village provide themselves with a building furnished with apparatus, collections in Natural History, books, &c.; to be used by themselves and a District Professor, or an experimental teacher, who shall visit in succession six or perhaps twelve towns in the same vicinity, and render what aid he can, in the business of *Self-Education*. He might perform experiments in Chemistry, and by that means enable the members of the Lyceum to perform them for each other. By making illustrations in Astronomy, Natural Philosophy, Geometry, or any other science, by appropriate apparatus owned by the Lyceum, he would enable the members to repeat and amplify the illustrations and explanations, at their meetings for *mutual improvement*. This scientific and experimental teacher, who should be employed by several of these schools, might render most efficient aid in procuring *Cabinets of Natural History*. Little more would be required of him, indeed, on this subject, than to give names to the minerals and other specimens they might collect, with some familiar lectures or descriptions of them. By such aid, not only Lyceums, but schools and families, would be supplied with cabinets, to illustrate the variety, richness, and grandeur of our Creator's works.

The expense of such courses of instruction, would be most trifling indeed. Suppose that twelve towns or villages in the same vicinity should pay a teacher one hundred dollars each, which, considering his travelling expenses and the qualifications he must necessarily possess, would probably be a proper compensation for one twelfth part of his time: what village or neighborhood is there which could not raise it without the least inconvenience? For fifty persons, it would be two dollars each; for a hundred, one dollar; and for two hundred, fifty cents. How could money be so well expended for schools? For the instruction and entertainment of adults? For good neighborhood? For social enjoyment? For temperance? For an acquaintance with different pursuits? For agriculture? For the mechanic arts? For domestic economy? For the art of living comfortably? For good gardens? For fruit? For public spirit? For the neat arrangements and common ornaments of a village? For public buildings? For roads? For preventing poverty? For checking crime? For diminishing the expense of prisons and of courts? For preventing abuse, contention, unkindness, and the rankling of evil passions? For cultivating generous feelings, magnanimity, and christian benevolence? And above all—*for setting a good example to other towns, other states, and other countries?*

Which of the readers of this article is not willing to risk fifty cents, or even two dollars, for such an object?

Perhaps it might be well for every one who does not consider the risk too great for him to run, to set the example, by paying his two dollars, and inviting his nearest neighbor to do the same, requesting him to give the same invitation to his neighbor, and so on.

The instructions of Mr. Hall, Mr. Jewett, Mr. Barton, Mr. Tenney, and other Agents of the Society, will present excellent opportunities for considering and experimenting on this subject. We hope every state, county, village, and neighborhood, will be able to procure some agent to assist them; at any rate, that they will have the assistance of their own efforts.

From the Journal of Education.

CARBON.

CARBON is one of the simple or elementary substances. Where this substance is not combined with any other, it exists in a solid state.—It is a principal ingredient in all vegetable matter; and it is as familiar to us as coal or charcoal. If we set fire to a piece of wood, it burns for some time with a flame. After a time, however, the flame disappears, and there remains nothing but a black substance, which we call coal; this coal is carbon, almost in a state of purity. The explanation of this phenomenon is this: a piece of wood is composed of carbon, or charcoal, and several other ingredients; and when we set fire to it, the heat of the wood, while burning, converts these other solid substances of which the wood is composed, to a gaseous or aeriform state; these pass off in this form, in the same way as when we heat a quantity of water so as to make it boil, it will pass off in the form of steam. All the parts of the wood, then, that can be made to assume the gaseous or aeriform state, by means of heat alone, are driven off in this form; while the coal which cannot be made to assume the gaseous state by the heat alone, remains solid.—I shall explain to you presently, the manner in which the coal itself may be made to assume the form of a gas.

The common charcoal that we use for fuel, is prepared by piling together a quantity of wood in the form of a pyramid, and covering it with turf, clay, or earth, leaving a few air holes; the wood is then set on fire; and as soon as the whole of it is kindled, the air holes are stopped up. In this process the covering of clay or turf prevents the combustion of the coal, while the other parts of the wood are burnt or driven off in a gaseous state.

Charcoal obtained in this manner is not perfectly pure carbon: it contains a very small quantity of earthly or alkaline substances, and an exceedingly small quantity of hydrogen. Almost the whole of the coal, therefore, is carbon.

Another form of carbon, in common use, is lamp black. The principal difference between this substance and charcoal is, that the lamp black is in the form of an impalpable powder, and some kinds of it contain a less proportion of impurities than charcoal; a lamp black prepared carefully from turpentine may be burnt without leaving any ashes, which form the principal part of the impurities of coal. There is one other substance which, from the most accurate experiments, is found to be pure carbon; this substance is the diamond; and I shall presently mention to you the experiment by which this fact is proved.

Charcoal is a very bad conductor of heat.—One end of a piece of it, an inch long, may be held between the fingers, while the other end is burning. It may, therefore, be advantageously used for several purposes connected with household economy. A double box, for instance, may be constructed, that would preserve ice for a long time in our common cellars, in the summer.—This may be done by taking two boxes, one much larger than the other in every direction; the smaller one is to be filled with ice, and is to be placed inside of the larger one; the vacant space between the two boxes, is then to be filled with powdered charcoal. The charcoal is so bad a conductor of heat, that only a small quantity of heat will pass through it to the ice in the smaller box.

Charcoal possesses the property of depriving bodies of their odour, taste, and colour. This property, in some cases, is a valuable one. The vinegar that is used in medical preparations, is purified by putting into it a quantity of newly burnt charcoal, and heating it. When water has become putrid by long standing in casks, it may be deprived of its putridity, by being filtered through charcoal powder. In long voyages, the water will often become putrid. In these cases, it is sometimes made good by putting a quantity of charcoal in the cask of water, and agitating it. The method, however, that is usually practised, is a better one; the inside of the cask is burnt to a coal, by which the putridity of the water is prevented. Even meat which has become somewhat putrid, may be deprived in a great measure of its bad odour and taste, by rubbing it with charcoal powder, and imbedding it in the powder.

Charcoal possesses the power of absorbing a certain quantity of the different kinds of gas; a piece of charcoal made from boxwood, and newly burnt, will absorb and condense into its own substance, nearly twice its bulk of hydrogen gas, about nine times its bulk of oxigen gas, and about twenty times its bulk of gaseous ammonia.—These gases may be driven off from the charcoal, by heating it. Charcoal, when exposed to the air, will also absorb a considerable portion of the moisture that the air always contains. It appears that the purifying power of charcoal depends, in some measure, upon this property of absorbing the different gases, and possibly somewhat upon that of absorbing moisture; for it is found that a piece of charcoal that has been exposed to the atmosphere, does not possess this antiseptic property in nearly so great a degree as a piece newly burnt. The reason is, that the charcoal that has been exposed, has absorbed a certain quantity of the gases of which the air is composed, and hence loses, in some measure, the power of absorbing more of the gases that may arise from the substance which is to be preserved.

Carbon has a strong attraction for oxigen, and it unites with it to form a gas; this gas has the properties of an acid, and is called carbonic acid gas. To produce this combination of charcoal, or carbon and oxigen, it is only necessary to set it on fire. I explained to you, in a previous lecture, that the atmosphere is composed of oxigen and nitrogen gases; and when we set fire to a piece of coal, almost the whole of it gradually unites with the oxigen of the atmosphere; and whilst this union is going on, light and heat are given out by the coal, and probably by the oxigen also. In other words, the coal burns, so that we lose sight of the whole of it, with the exception of the small quantity of ashes that remains.—The coal, therefore, by being burnt, is not destroyed, as we have not the power of destroying any kind of matter; it merely changes its form, and from a solid substance it becomes a gaseous or aeriform one. You have probably observed that when salt is put into a tumbler, and water poured upon it, the salt will gradually disappear. In this case, the salt is not lost, but dissolved in the water. It is in a manner somewhat like this, that a piece of coal, after it is set on the fire, becomes dissolved in the oxigen gas of the atmosphere, and unites strongly with it. If a piece of coal be set on fire, and introduced into a jar of oxigen gas, it will burn with much greater brilliancy than in the atmosphere. The experiment by which it is proved that the diamond is nothing but pure carbon, is its combustion.—When the diamond is heated to a red heat, and introduced into a jar of oxigen gas, it burns; that is, it unites with the oxigen; and by their union there is produced nothing but pure carbonic acid gas. The diamond, a piece of charcoal, and lamp black, are, then, the same substance, excepting that there is added to the two latter an exceedingly small quantity of other substances. The principal difference between them is, that the carbon in the two latter is in the form of a black opaque substance, while in the diamond it is crystallized so as to form the hardest substance known, and the most brilliant of the precious stones.

Carbonic acid is colorless like our atmosphere; and when contained in a bottle, we cannot see it any more than if the bottle were filled with common air. It is one of the weakest of the acids; but it is at the same time one of the most important. You were informed in a previous lecture, that one of the properties, by which many of the acids may be known, is that of converting the blue color that may be obtained from some vegetables, to a red; this property is possessed by carbonic acid. We can obtain a blue liquid by boiling in water some leaves of the blue cabbage; if a small quantity of this blue liquid be poured into a glass vessel of this gas, and then agitated, the liquid will become red. Although carbonic acid exists in a gaseous form, when uncombined, it may be made to assume a solid form by uniting it with some other substance. Chalk, marble, and limestone are all composed of carbonic acid united to lime. A hundred parts by weight of these substances, contain usually about forty four parts of carbonic acid; and the remaining fifty six parts are principally lime with small portions of other ingredients. It may be shown by an experiment that carbonic acid becomes solid, while uniting with lime. Let a small piece of quick lime be put into a glass vessel, containing water; the water will dissolve a small portion of the lime. We must now take a bladder containing carbonic acid gas, with a pipe stem inserted into its neck, and dip the end of the pipe stem into the solution of lime in the water. By squeezing the bladder, the gas will bubble from the end of the pipe stem, through the solution; and as it passes through it, it will combine with a portion of the lime, that was dissolved in the water.—The combination of lime and carbonic acid thus formed, is almost insoluble in the water; and it therefore falls to the bottom of the vessel. As it is in the form of very light powder, however, it will remain suspended for some time in the water, giving it a cloudy appearance.

There are other acids that have a stronger attraction for lime than carbonic acid has; the attraction between lime and sulphurous acid is stronger than that between carbonic acid and lime. If, therefore, we pour upon a piece of chalk some sulphuric acid, it will unite with the lime which is one ingredient of the chalk; and the carbonic acid will be set free from its combination with the lime; and being left alone, it assumes the state of a gas, and passes off in that state. It is well to put a little water on the chalk, before pouring on the acid; and then the gas may be perceived bubbling up through the water.

The following is the best method of procuring carbonic acid gas for chemical experiments. A piece of chalk or marble, half the size of a small apple, is to be broken into small pieces, and put into a retort; and half a wine glass of sulphuric acid, (oil of vitriol,) diluted with its bulk of water, is to be poured upon it. The carbonic acid gas will be copiously disengaged, and may be collected in receivers over water. The chemical name for marble, chalk, and limestone, is carbonate of lime.

Carbonic acid is formed in caverns, mines, and deep wells; it is called by the miners chokedamp: the common name for this gas is fixed air

If a candle or any other common combustible substance be lighted, and introduced into a jar of carbonic acid gas, it will be extinguished.

Carbonic acid gas is much heavier than common air. If, therefore, a jar of it be held with its mouth downward for a few seconds, the gas will all fall out of the jar, because it is heavier than the common air; while if the jar remain with its mouth upward, the gas will remain in it for some time. It will, however, gradually mix with the common air, and at last all escape. This gas, from its weight, may be poured from one vessel into another; if a piece of lighted candle be placed at the bottom of a jar or tumbler, and some of the gas be poured from another jar the flame of the candle will be extinguished.—When this gas is found in vats or deep wells, there is usually the greatest quantity of it near the bottom of the vat or well, and persons are sometimes in danger of losing their lives by descending into them. As a candle will not burn where this gas has taken the place of the common air, and we can test its presence by lowering a candle into the well, if there be so much of the gas present, that the candle is extinguished, it would not be safe for any one to venture into the well or vat.

It is well known that persons have frequently lost their lives by remaining in a room where charcoal was burning. The reason of this is, that almost the whole of the oxigen of the atmosphere unites with the charcoal or carbon, and forms by this union, carbonic acid gas. You were informed in a previous lecture that the only gas upon which we could live for any length of time was oxigen gas, diluted as it is in our atmosphere, with a large bulk of nitrogen gas. There is to be sure, oxigen gas in the carbonic acid gas; but the oxigen gas in this state is strongly united with a portion of carbon; and in this state, it will not yield any more support to our breathing than water would, if we were immersed in it. I have found that in some places, there is an opinion quite prevalent, that there is not any danger in remaining in a room where there is a pan of coals burning that have been taken from a common wood fire. This is a mistake; the coals from a common wood fire are exactly the same substance as the charcoal; and equal quantities by weight of these coals and of charcoal, will produce exactly equal quantities of carbonic acid gas. It is also by some persons supposed, that after charcoal has been burning for some time in a fire place, there is a deleterious quality that gets burnt out of it, and that then it may be burnt in a close room without danger. It is scarcely necessary for me to say that this is also an error.

The Lehigh and Schuylkill coals are composed of carbon united to a portion of some earthy substances; and in the burning of these coals, that is in the uniting the carbon which they contain, with the oxigen of the atmosphere, there is carbonic acid produced, and of course there would be danger in burning these in a close room, as well as in burning charcoal.—This would be the case also, in burning cannel, and other bituminous coals; as their principal ingredient is carbon.

Carbonic acid gas, unlike the gases of our atmosphere, has a pungent and agreeable taste.—If a quantity of this gas be condensed upon the surface of some water, the water will absorb it, and will acquire a pungent taste, which is derived wholly from the carbonic acid. The pungency of soda water is derived from this acid. To prepare this beverage, a very small quantity of carbonate of soda is put into water contained in a strong cask, and there is then crowded into the cask a large quantity of carbonic acid gas, which becomes absorbed by the water, and which then constitutes our common soda water. The object in dissolving in the water the small quantity of soda, is, to induce the water to absorb much more of the carbonic acid than it otherwise would.—As soon as any of this soda water is drawn off from the cask, there escapes from it a considerable quantity of air; this air or gas is carbonic acid; and it is evident that the pungency of the soda water is derived from the acid, because if the liquid be exposed to the air for some time, almost all the carbonic acid will escape from the water, which will lose its sharp taste. Beer, cider, and Champagne wine, that have been kept in bottles, contain a quantity of this acid, which escapes when the liquid is poured into a tumbler. The pungent taste of these liquids also depends upon this acid; as agitating them favours the escape of the carbonic acid, they should be poured carefully from the bottle, without raising its neck from the tumbler.

Carbon has also a strong attraction for hydrogen, and it unites with it in two different proportions to form two gases.

The compound of carbon and hydrogen in which there is the smallest quantity of carbon, is called subcarburetted hydrogen. This gas is combustible, and it burns with a yellow flame, like that of a candle; it is destitute of colour, taste, and odour. This gas may be procured from the muddy bottoms of ditches and pools; to collect this gas we must hold a wide-mouthed vessel with its mouth downward, in the ditch water, being careful that the vessel is filled with the water, before it is inverted. If the bottom of the ditch below the vessel be stirred with a stick, a quantity of air bubbles will arise into the vessel and displace the water. The air thus collected will be found to be carburetted hydrogen, mixed with a portion of some other kinds of gas; and if a lighted taper be applied to it, it will take fire. If from six to twelve parts of common air be mixed with one of this gas, and the mixture be set on fire, it will explode. Subcarburetted hydrogen is frequently generated in coal mines, and becoming mixed with the common air of the mine, explosive mixtures are formed. In the extensive coal mines in England, very large quantities of these explosive mixtures are frequently produced. A few years ago, these mixtures would take fire by the lamps used by the miners, producing the most tremendous explosions, and destroying the lives of many of the workmen. There was an explosion in one of the Newcastle collieries, by which one hundred and one persons perished in an instant. There has been discovered, however, an expedient that prevents these dreadful calamities. The remedy consists in nothing more than a cylinder of wire gauze, fastened upon the upper part of the lamp, which the workmen are obliged to use. This round cage or cylinder of wire gauze, is about one inch and a half in diameter, and six in length, and is fastened by means of a screw to the upper part of the lamp, so as to surround the flame; and all the air which feeds the flame of the lamp must pass through the apertures. The lamp thus guarded, may be used with perfect safety, in the most dangerous explosive mixtures, where the naked flame of a lamp would produce an instantaneous explosion. The explosive mixture passes through the apertures to the inside of the cage; it burns in the cage; and the flame will sometimes come in contact with the inside of the gauze; yet there is not any danger of its passing through the apertures, so as to set fire to the gas on the outside, and produce an explosion. This lamp was the discovery of Sir Humphrey Davy, and it was the result of a long investigation of the laws and nature of flame.

The other gas resulting from the combination of carbon and hydrogen, contains twice as much carbon as the one first mentioned, and is called carburetted hydrogen. This gas is colourless like our atmosphere, and it burns with a brilliant white flame. The gas that has been so much used for several years past, for lighting large towns and cities, is a mixture of the two gases just described; they are procured from coal or oil. To prepare these gases, an iron retort is heated to redness, and then the coal or oil is put into it. If oil be used, it is suffered to run into the red hot retort only in very small streams. The gas from oil contains a larger proportion of the carburetted hydrogen, than the coal gas; and as carburetted hydrogen burns with a much more brilliant flame than the subcarburetted hydrogen, the oil gas will burn with a brighter flame than the same quantity of coal gas. The flames from burning wood, oil, or coal, are all of them the flames of one of these gases, or more probably in most, the flame of the two gases, the carburetted and subcarburetted mixed in different proportions.

QUESTIONS ON LYCEUM No. 4.

How can lads and young men attain to the highest degree of intellectual and moral improvement; under a support by money from their parents, or from their own industry?

How much time ought a person to be actually engaged in study and labor, ten or twelve hours a day?

How much sleep has been proved by experience to be necessary to promote the greatest vigor of mind and body, eight, six, or five hours in twenty-four?

How much time ought a student to be engaged in study and instruction, to make the greatest and most solid improvement, six, eight, or ten hours a day?

Which will give the highest dignity and independence of character to a student, support from his own productive industry, or from the money of friends?

Which will give a student the best acquaintance with *men* and *things*, confining his attention entirely to books, or *working with his hands* on the productions of his CREATOR, and the materials used in the arts and business of life?

What are some of the facilities necessary to put into the hands of students, to enable them to *support and educate themselves*?

What common things in the language of science are called oxids?

Why is the term oxid preferable to rust or dross?

Which is most difficult to reduce to a metalic state, the oxid of iron, or of lead?

What are examples of oxids of iron; also of lead?

What is the most abundant ingredient in rocks and soils, next to quartz, felspar, or mica?

Which is found in the largest masses, quartz or felspar?

Of what rocks does felspar form a part?

Which of the arts is felspar used for, the manufactory of glass or porcelain?

What alkali constitutes a part of felspar, and renders it partially fusible, potash or soda?

Where are specimens of felspar most abundant, in the Atlantic states, or in the Western Valley?

What species of felspar is used for the manufactory of porcelain in Philadelphia, and where obtained?

Which is most expanded by heat, air or water?

Who most justly appreciate the works of their Creator, and exercise the greatest taste and skill in studying and arranging them—children of three years old, or those appointed to legislate for the education of children?

Which is probably most offensive to God, the religious mockery of some fashionable assemblies in Christian countries, or the superstition and idolatry of Mahometans?

What geometrical figure is more used than any other, in its application to science and the arts?

Which is most useful among the triangles, the equilateral, isoceles, scalene, rightangled, obtuse, or acute?

Which of the above named triangles have two equal sides, and the third longer or shorter than the other two?

In learning children to count, which ought to be presented first, words or ideas?

Is it a benefit or an injury to children, to repeat the names of numbers, or to be learnt to count up to ten, before they learn what the previous numbers mean?

What instrument is prepared to aid children in comparing and combining numbers?

What is the most elementary instrument in machinery, especially in animal machines?

Would Lyceum buildings, erected in all our towns and villages throughout the country, increase or diminish the current expenses of those communities?

What are some of the accommodations most desirable in a Village Lyceum?

Which will be likely to render the most efficient aid in furnishing lyceums as well as schools, with cabinets of Natural History—children or adults?

How many children in the United States can be induced to render their gratuitous services, in collecting cabinets of Natural History for families, schools, and lyceums?

What would be some of the advantages, in having Town, County, State, and National Lyceums, furnished with cabinets of Natural and Artificial productions?

How can Town Histories be procured; and how can Lyceums engage in procuring them, and Town Maps, representing the Geography, Geology, Topography, Agriculture, and something of the Statistics, of the districts they delineate?